(12) UK Patent Application (19) GB (11) 2 310 342 (13) A

(43) Date of A Publication 20.08.1997

(21) Application No 9603316.2

(22) Date of Filing 16.02.1996

(71) Applicant(s)
Northern Telecom Limited

(Incorporated in Canada - Quebec)

World Trade Center of Montreal,
380 St Antoine Street West,8th Floor, Montreal,
Quebec H2Y 3Y4, Canada

(72) Inventor(s)
David Alan Brown

(74) Agent and/or Address for Service
Nortel Patents
London Road, HARLOW, Essex, CM17 9NA,
United Kingdom

(51) INT CL^6
H04B 1/40 , H04Q 7/32

(52) UK CL (Edition O)
H4L LDSC L1H1A L1H1D L1H10 L30

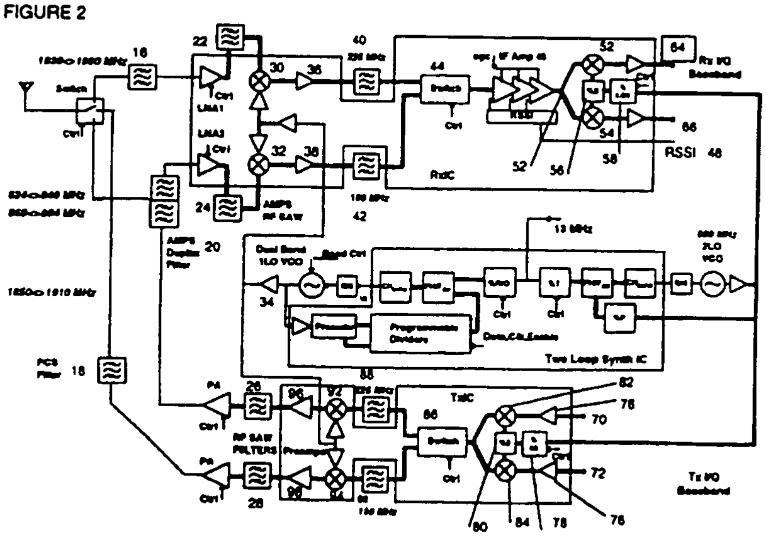
(56) Documents Cited
GB 1601708 A EP 0678974 A2 EP 0656735 A2
EP 0621683 A2 EP 0595781 A2 EP 0581573 A1

(58) Field of Search
UK CL (Edition O) H3A AB , H4L LDSC LECX
INT CL^6 H04B 1/40 1/50 1/54 1/56 , H04Q 7/32 7/38
ONLINE : WPI

(54) **Dual mode radio transceiver front end**

(57) A dual mode radio front end transceiver which is operable on two different frequency bands and two different modulation formats has receive IF circuitry 46,52,54 common to both modes, transmit IF circuitry 76,78,82,84 common to both modes, and only two frequency synthesisers from which all the local oscillator requirements are derived. The transceiver may be a cellular mobile radio handset operable on the digital PCS 1900 system and on the analog AMPS system. A single first local oscillator may be used with a dual band VCO and a programmable synthesiser, overlap tuning being employed to constrain the VCO tuning range to be appropriate for the dual bands. A single 900 Mhz second local oscillator may be used with integer division to derive the second mixer local oscillator signals required for the dual modes. An additional IF stage may be employed in the receive circuitry (Fig.5), the required further local oscillator signals being derived from the 900 Mhz oscillator. A first chip may carry the receiver front end, a second chip the transmit front end, and a third chip the two frequency synthesisers.

FIGURE 2



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

GB 2 310 342 A

FIGURE 1

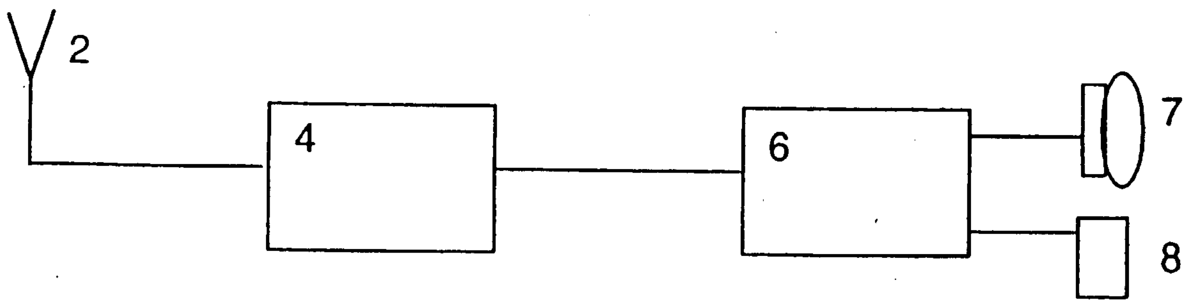
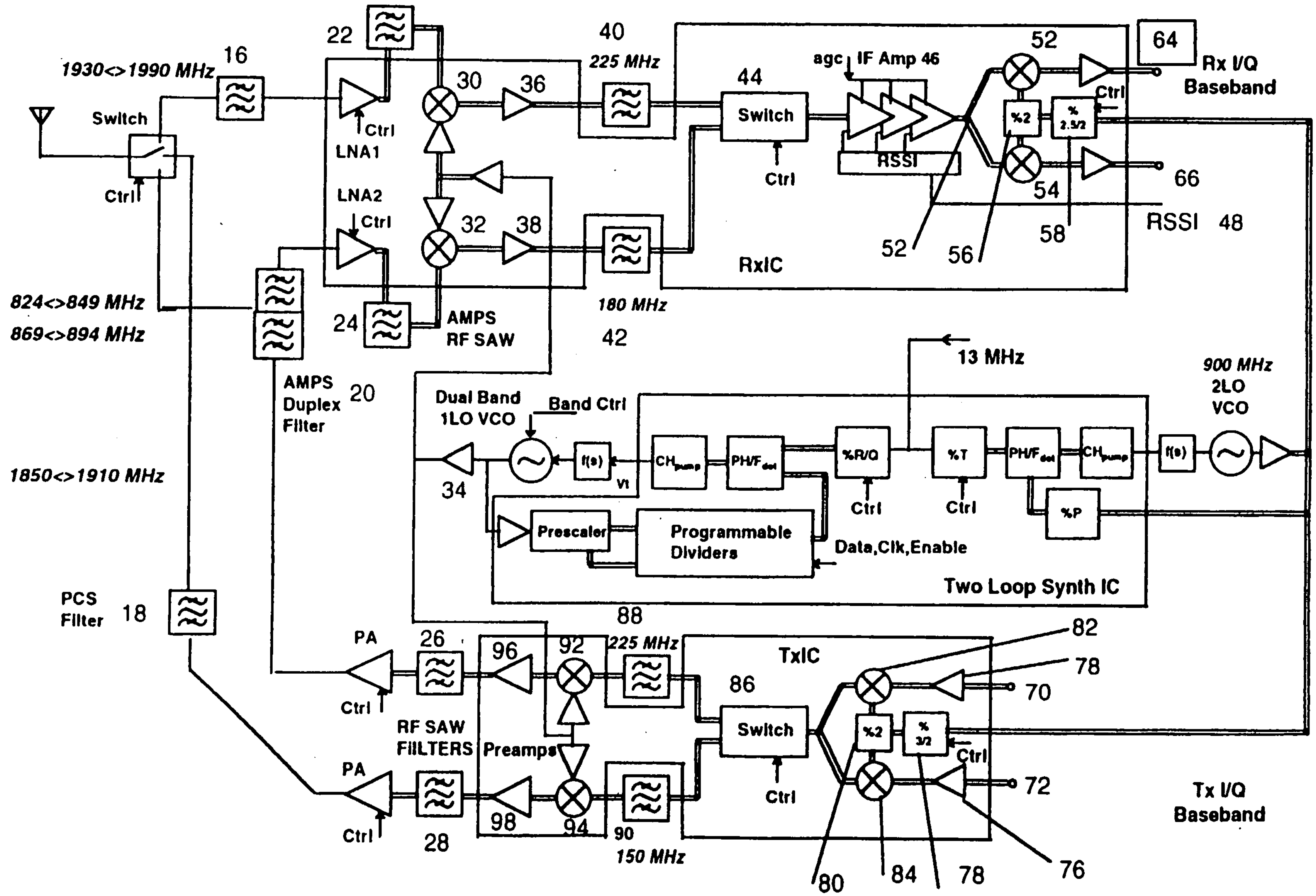
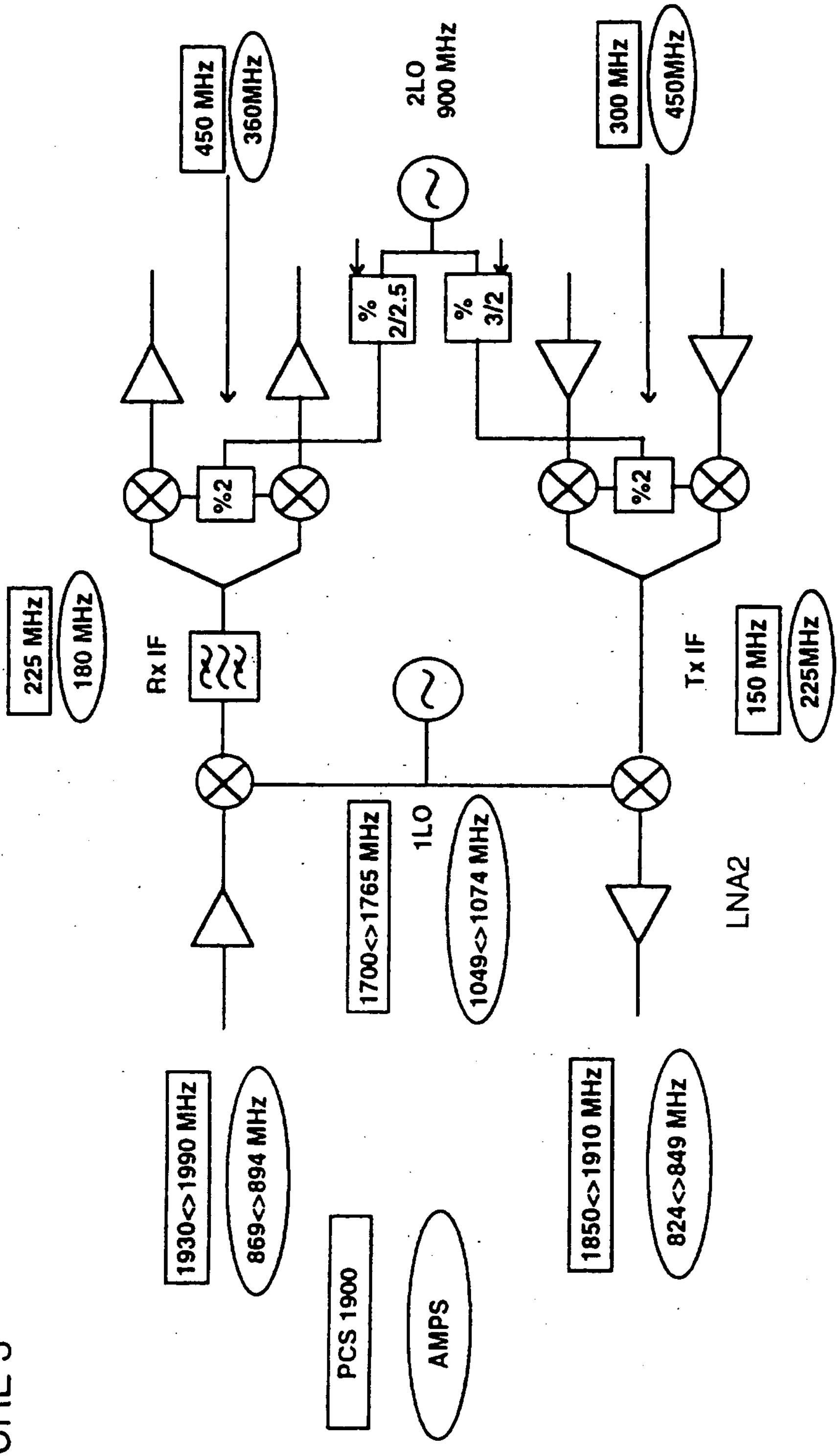


FIGURE 4

	Tx	Rx	
PCS 1900	1850<>1910 MHz	1930<>1990 MHz	
	-150	-225	
	Tx 1LO 1700<>1760 MHz	Rx 1LO 1705<>1765 MHz	Overall 1LO 1700<>1765 MHz => 65 MHz tuning range
AMPS	824<>849 MHz	869<>894 MHz	
	+225	+180	
	Tx 1LO 1049<>1074 MHz	Rx 1LO 1049<>1074 MHz	Overall 1LO 1049<>1074 MHz => 25 MHz tuning range

FIGURE 2


1930<>1990 MHz
16
Switch
Ctrl
22
LNA1
LNA2
Ctrl
30
36
32
38
24
AMPS
RF SAW
824<>849 MHz
869<>894 MHz
AMPS
Duplex
Filter
20
1850<>1910 MHz
PCS
Filter
18
40
225 MHz
180 MHz
42
44
Switch
agc
IF Amp 46
RSSI
RxIC
52
54
56
58
64
Rx I/Q
Baseband
66
RSSI 48
13 MHz
Dual Band
1LO VCO
Band Ctrl
34
f(s)
Vt
Prescaler
Programmable
Dividers
Data,Clk,Enable
Two Loop Synth IC
%R/Q
%T
%P
900 MHz
2LO
VCO
88
PA
26
96
92
225 MHz
TxIC
86
Switch
82
78
70
72
76
80
84
RF SAW
FIILTERS
Preamps
98
94
90
150 MHz
28
Tx I/Q
Baseband



1930<>1990 MHz
869<>894 MHz
1850<>1910 MHz
824<>849 MHz
1700<>1765 MHz
1LO
1049<>1074 MHz
LNA2
Rx IF
225 MHz
180 MHz
Tx IF
150 MHz
225MHz
%2
%2
%
2/2.5
%
3/2
2LO
900 MHz
450 MHz
360MHz
300 MHz
450MHz
PCS 1900
AMPS

FIGURE 3

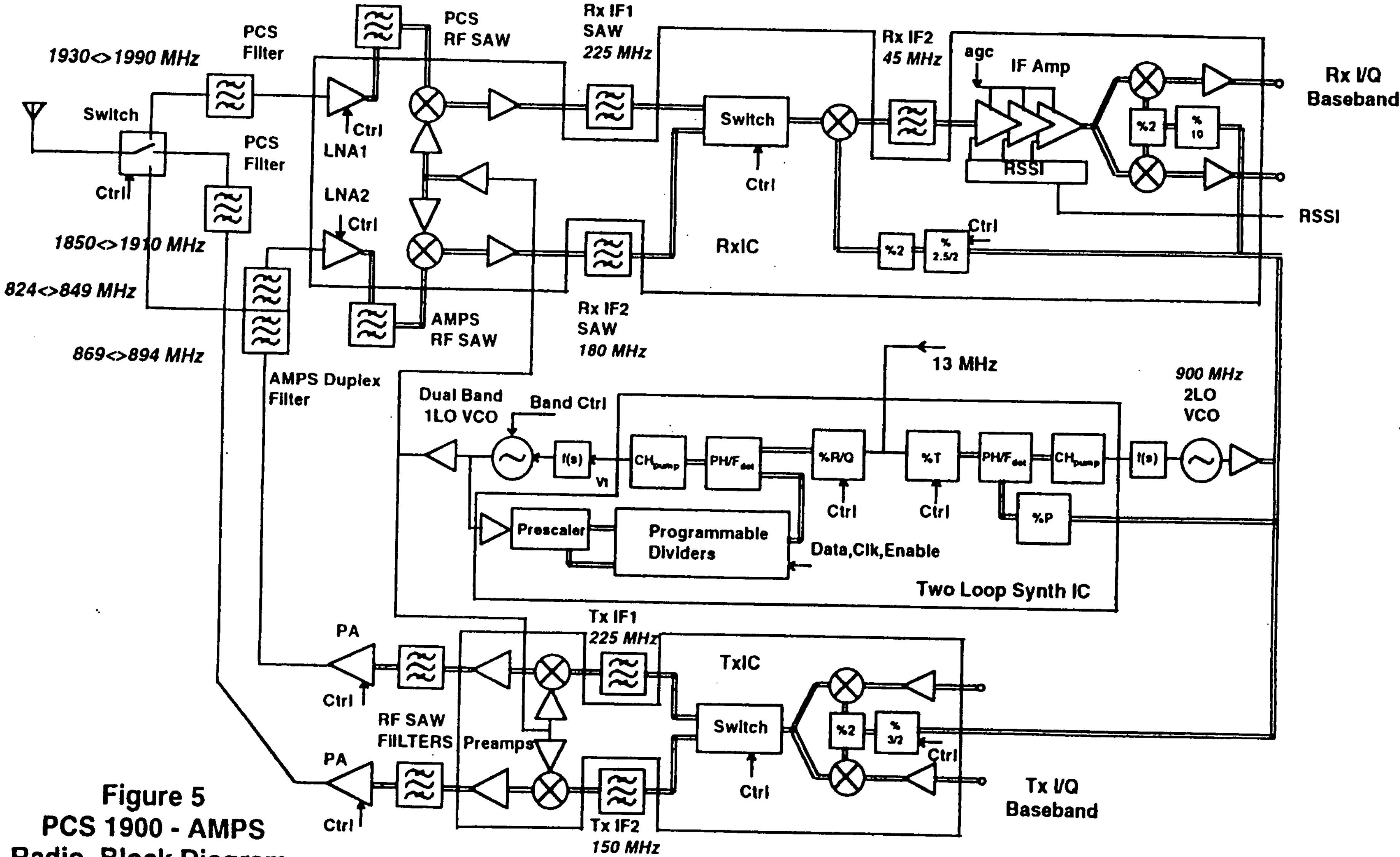


Figure 5
PCS 1900 - AMPS
Radio Block Diagram,
Additional IF version

Figure 6

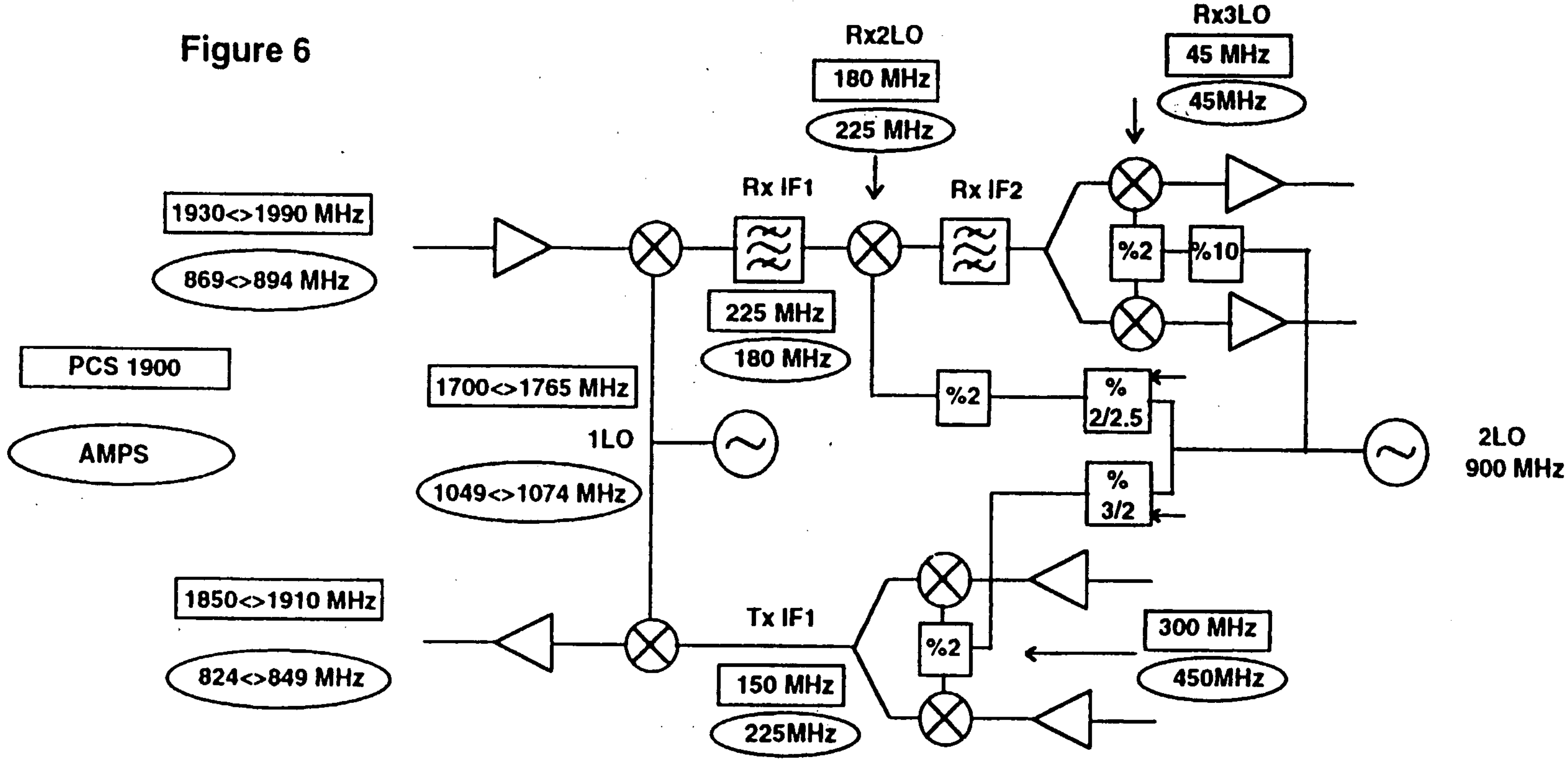


Figure7

PCS 1900	Tx 1850<>1910 MHz -150 Tx 1LO 1700<>1760 MHz	Rx 1930<>1990 MHz -225 Rx 1LO 1705<>1765 MHz	Overall 1LO 1700<>1765 MHz => 65 MHz tuning range
AMPS	Tx 824<>849 MHz +225 Tx 1LO 1049<>1074 MHz	Rx 869<>894 MHz +180 Rx 1LO 1049<>1074 MHz	Overall 1LO 1049<>1074 MHz => 25 MHz tuning range

A DUAL MODE RADIO ARCHITECTURE

Field of Invention

The present invention relates to a dual mode radio architecture and, in particular, relates to the same for use in a mobile radio handset.

Background Art

Personal communication networks are being deployed extensively world-wide using cellular mobile radio systems. Early networks, still in operation, use analogue modulation formats for the radio air interface protocol. These analogue networks exhibit the problem of call saturation in high usage areas. To overcome this problem higher capacity air interface protocols using digital modulation format networks have been introduced in tandem, that is an area is covered by both systems.

In a large country such as the United States or Canada the early standardised analogue network known as AMPS has reached a fairly universal coverage of the populated North American continent. The newer digital networks tend to be deployed in areas of high usage. A result of this is that there are areas of digital network coverage overlaying a universal analogue network coverage. Additionally different air interface protocol standards of digital networks have been deployed regionally, since different telecommunications operators have developed their own protocols or have developed such protocols in line with national and sometimes international standards authorities, for example, the GSM protocol. Whilst it is reasonable to suppose that handsets operable for different radio communications protocols are similar from the users point of view, it is not possible, in particular, to use a digital mobile radio for use in an analogue cellular region and vice versa. This stems from the fact that whilst both types of handsets possess antennas, radio front end transmitter, receiver and baseband

circuits, they operate on different air interface protocols with different radio carrier frequencies, duplex timing and modulation formats, which are incompatible.

Therefore it can be seen that each individual personal communications system user will need a dual network service for complete coverage. Consequently the user requires a handset that will not only function throughout the coverage area of the specific subscribed-to digital network, but also have a switched alternative mode to operate on the universal analogue network.

The problem of implementing a dual mode handset has been considered to be surmountable by two different approaches: The first solution uses two separate radio transceivers piggybacked and combined at the antenna and at the man-machine interface (keyboard and audio); The second solution uses two separate radio sections piggybacked and combined at the digital signal processing part of the radio transceiver.

These two approaches have problems in that they are complicated and unwieldy, and it is clear that a dual-mode radio architecture with an increased functional commonality of circuits would be the most cost effective solution. Accordingly, it is an object of the present invention to overcome these problems.

Statement of Invention

In accordance with one aspect of the present invention, there is provided a dual mode radio front end transceiver operable to receive and transmit radio signals in different frequency bands and modulation formats, the transceiver comprising;

receive and transmit paths for each modulation format, wherein common receive and transmit intermediate frequency circuitry is employed and the local oscillator requirements are derived from two frequency synthesisers.

Preferably, a single first local oscillator is used and the required dual mode operation is achieved by using a dual band voltage controlled oscillator and a programmable synthesiser. Preferably, the first local oscillator employs overlap tuning in order to constrain the voltage controlled oscillator tuning range appropriate for the dual band.

Preferably, a single second local oscillator is used, wherein the required dual mode operation is achieved by integer division of the local oscillator to derive the required local oscillator input signals.

In an alternative embodiment, an additional intermediate frequency is employed for receive and transmit, without the need to provide additional oscillators.

Preferably, the higher frequency radio system local oscillator bands are arranged to overlap, by switching intermediate frequencies, whereby the tuning range is constrained to within that achievable for a defined speed of phase lock loop.

Preferably, the transceiver is provided with a means to determine whether the operational mode.

In accordance with another aspect of the present invention, there is provided a radio transceiver comprising a combination of functional block circuits and frequency plan,

wherein, in a first circuit, disparate radio air interface signals are downconverted, with a first local oscillator, and filtered with switched separate intermediate frequency filters, amplified and converted using a second local oscillator, to in-phase and quadrature baseband signals, in a common sub-system of functional blocks,

wherein, in a second circuit, disparate baseband modulation format in-phase and quadrature signals are upconverted in a common subsystem of functional blocks, using a second local oscillator, and filtered with switched separate intermediate frequency filters, further

upconverted using a first local oscillator, to the disparate radio air interface signals,

wherein, the frequency synthesis is arranged so that only two phase locked voltage controlled oscillators are required, with the four second local oscillator frequencies all integer relationship derived from the prime second local oscillator, itself phase locked to the frequency reference, and the first local oscillator frequencies all derived from the same reference frequency, with the higher frequency radio system local oscillator bands arranged to overlap, by switching intermediate frequencies, so as to constrain the tuning range to within that achievable for a defined speed of phase lock loop.

Brief Description of Drawings

In order that a greater understanding of the invention be attained, an embodiment of the invention will now be described with reference to the accompanying drawings, wherein:-

Fig. 1 depicts a typical handset schematic;

Fig . 2 is a detailed implementation of a radio front end made in accordance with the invention

Fig. 3 is a schematic diagram of the front end depicted in figure 2;

Fig. 4 is a frequency plan of a radio front end made in accordance with one embodiment of the invention;

Figs. 5 and 6 are the block and frequency plan schematics of another version of the architecture with an additional intermediate frequency; and

Fig. 7 is a frequency plan of a radio front end made in accordance with one embodiment of the invention.

Figure 1 shows a block diagram of a typical cellular radio handset. Radio frequency signals are received and transmitted by the antenna 2 which is connected to a radio front end 4. In the radio front end transmit and receive signals are converted between radio frequency

and base band, whereby digital signal processing means 6 encode the transmit and decode the receive signals and from these can determine the audio signals which are communicated to and from the handset user by loudspeaker 7 and microphone 8. The front end will typically contains transmit and receive paths which are mixed to an intermediate frequency with a local oscillator. These intermediate frequency signals will be further processed and mixed so that the input and output signals to and from the front end are at baseband and suitable for digital to analogue or analogue to digital conversion, as appropriate, prior to digital signal processing.

Referring now to Figure 2, there is shown one embodiment of the present invention, comprising a dual mode radio front end for the reception of both digital PCS 1900 signals and analogue AMPS signals. PCS 1900 operates in the frequency band 1930 to 1990 MHz on the receive downlink to the handset and in the 1850 to 1910 MHz band on the transmit uplink from the handset. AMPS operates in the frequency band 824 to 849 MHz on the receive downlink to the handset and in the 869 to 894 MHz band on the transmit uplink to the handset.

PCS 1900 operates either in an uplink mode or in a downlink mode: AMPS can operate in both modes simultaneously. For this reason the switch 14 from the antenna 12 has three positions. Band pass filters 16,18 are provided on the input and output lines for the PCS signals whilst a single duplex filter 20 is employed for the input and output lines of the AMPS signals. Low noise amplifiers LNA and power amplifiers PA are provided on the input and output lines respectively.

Further band filters 22, 24,26 and 28 are provided from the outputs of the LNAs and to the inputs to the PAs. Preferably these filters are radio frequency surface acoustic wave SAW devices. These SAW devices can be fabricated on quartz, as is known. The advantages provided are such that the receive band can be converted down to a channel of commensurate width, so that over the RF band a large number of channels can be determined .

Turning now to the receive path for the digital PCS1900 signals, when the switch 14 directs incoming digital PCS1900 signals to the PCS 1900 receive path, the signals from the band select filter 22 are passed to a mixer 30 which mixes the received signal with a signal from a synthesised local oscillator 34 to produce an intermediate frequency (IF) signal at 225 MHz which is subsequently amplified by further amplifying means 36. The PCS 1900 signals are then filtered by the 225 MHz IF channel filter, and the filtered IF signal is then passed through a second switching circuit 44 which operates simultaneously with the first switch 14 by a mode control means (not shown). The mode control means identifies whether the signals are digital or analogue modulation and determines in which mode the transceiver is operating.

The receive signal output from switch 44 is fed to an IF amplifier with automatic gain control and a receive signal strength indicator (RSSI). After amplification, the signal path is routed through splitter 50 and the signals are output to a mixer pair 52 and 54, and after mixing with a quadrature 225 MHz signal derived through switchable division in 56 and 58 from a synthesised 900 MHz second local oscillator (2LO), in-phase and quadrature baseband signals are amplified by amplifiers 60 and 62, to provide output signals at 64 and 66 to be fed to the analogue to digital converters and digital signal processing means (not shown).

If an analogue AMPS radio signal were present at the antenna and a decision made to receive that signal, the switch 14 would feed the signal from the antenna 12 through duplex filter 20, amplifier LNA2, filter 24 to mixer 32. At mixer 32 the radio frequency signal is downconverted, using a synthesised local oscillator to a further intermediate frequency (IF) of 180 MHz which is different from that of the digital PCS1900 case. This IF signal is subsequently amplified by amplifying means 38 before channel selection by the 180 MHz filter means 42. The 180 MHz IF signal is then passed through the switching circuit 44. As in the case with the digital PCS1900 signal, the

analogue AMPS IF signal is output through the common IF amplifier , which, after amplification and mixing with a quadrature 180 MHz local oscillator signal derived through switchable dividers 56 and 58 from the second local oscillator (2LO), in-phase and quadrature baseband signals are provided at 64 and 66 to be fed to the analogue to digital converters and digital signal processing means (not shown).

The custom receive IC uses separate PCS1900 and AMPS LNA/down converters with external SAW image filters. Separate balanced termination SAW intermediate frequency filters at 225 MHz and 180 MHz are used for PCS1900 and AMPS. The PCS1900 intermediate frequency filter has a passband width of 300 kHz . The AMPS intermediate frequency filter can exhibit a passband width 3 channels wide at approximately 90 KHz, as in deployment the AMPS system avoids using adjacent channels in a cell cluster.

For transmit, the PCS1900 and AMPS baseband signals are raised to 150 MHz and 225 MHz intermediate frequencies (IFs) respectively. These baseband signals, derived from digital signal processing and digital to analogue converters (not shown), are input at ports 70 and 72, and are amplified by amplifiers 74 and 76 prior to upconversion in the quadrature modulator combination of mixers 81 and 84, using one of two local oscillators, at 150 MHz for PCS and 225 MHz for AMPS, derived through switchable division in 78 and 80 from the 900 MHz synthesised second local oscillator. The upconverted IF containing either the PCS1900 signal at 150 MHz or the AMPS signal at 225 MHz is applied to the switch 86 and transmit IF filter combination 88 and 90 in order to select the required IF. Either of the two IFs are then upconverted in mixers 92 or 94 to the PCS1900 transmit band at 1850 to 1910 MHz and the AMPS transmit band at 869 to 894 MHz. The respective signals are RF band filtered by 26 and 28 prior to power amplification and then fed to the antenna via separate filters and switch 14.

In terms of the frequency generation or local oscillator requirements for this dual mode radio, Figures 2 and 3 illustrate that all the required

local oscillator frequencies are derived from two voltage controlled oscillators, referenced via two phase lock loops to 13 MHz.

The custom transmit IC transmit path uses a quadrature circuit to modulate the I/Q baseband to one of two switched intermediate frequencies, dependent on the system in use and whether in transmit or receive. These transmit intermediate frequency filters will not need to be of high shape factor. Separate transmit upconverter sections can be used with external SAW filters operable to select the required bands.

With reference to the radio frequency plan of Figure 3, it can be seen that the first local oscillator signals are derived from a single dual band voltage controlled oscillator (VCO). Band selection operation of the first local oscillator VCO in the frequency band 1700 to 1765 MHz for the digital PCS1900 case or in the frequency band 1049 to 1074 MHz for the analogue AMPS case is used and four intermediate frequencies (IFs) result. These four IFs have been arranged to be integer related to the 900 MHz second local oscillator (2LO) and to be at frequencies convenient for SAW channel filter implementation. The four quadrature signal local oscillators required to mix the four IFs down to baseband are readily derived by division from the 900 MHz 2LO. For the PCS1900 receive state the 1930 to 1990 MHz band is downconverted to a 225 MHz IF using a channel tuning synthesised 1LO covering the range 1705 to 1785 MHz. The channel filtered 225 MHz IF is downconverted to baseband in-phase and quadrature signals using a 225 MHz quadrature local oscillator derived from the 900 MHz 2LO.

For the PCS1900 transmit state in-phase and quadrature baseband signals are upconverted to a 150 MHz IF using a 150 MHz quadrature local oscillator derived from the 900 MHz 2LO. The filtered 150 MHz IF is upconverted to the 1850 to 1910 MHz band using a channel tuning synthesised 1LO covering the range 1700 to 1760 MHz.

For the AMPS receive state the 869 to 894 MHz band is downconverted to a 180 MHz IF using a channel tuning synthesised

1LO covering the range 1049 to 1074 MHz. The channel filtered 180 MHz IF is downconverted to baseband in-phase and quadrature signals using a 180 MHz quadrature local oscillator derived from the 900 MHz 2LO. For the AMPS transmit state in-phase and quadrature baseband signals are upconverted to a 225 MHz IF using a 225 MHz quadrature local oscillator derived from the 900 MHz 2LO. The filtered 225 MHz IF is upconverted to the 824 to 849 MHz band using a channel tuning synthesised 1LO covering the range 1049 to 1074 MHz.

A feature of the 1LO synthesised frequency generation is that the transmit and receive local oscillator tuning bands are arranged to overlap by using different transmit and receive IFs. In this way the overall tuning range of the 1LO for PCS1900 can be constrained such that transmit to receive switching can be achieved in an allowable time. It is a requirement in the AMPS case for the transmit and receive local oscillators to tune the same range and channel as the AMPS radio simultaneously transmits and receives.

The four quadrature second local oscillator signals are derived from the prime 900 MHz 2LO as follows. The prime second local oscillator provides a synthesised 900 MHz signal which is fed to a switchable divide by two or divide by two/five divider 58 and subsequently a divide by two divider 56 on the receive path resulting in a 225 MHz or 180 MHz local oscillator. For the transmit path the 900 MHz is fed to a divide by three or divide by two divider 78 and subsequently to a divide by two divider 80 resulting in a 150 MHz or 225 MHz local oscillator.

On uplink, the PCS1900 and AMPS baseband in-phase and quadrature signals are raised to 150 MHz and 225 MHz intermediate frequencies respectively. The baseband IF signals are input at ports 70, 72 as in-phase and quadrature components and amplified by amplifiers 74, 76, then upconverted by mixers 82, 84, using one of two second local oscillators derived through a switchable divide by three / divide by two divider 78 and subsequently a divide by two divider 80 to produce 225 or 150 MHz from the prime 900 MHz second local

oscillator, to two transmit intermediate frequencies at 150 MHz and 225 MHz for PCS 1900 and AMPS respectively. These intermediate frequencies are then separated by switch 86 and filters 88 and 90 such that the PCS1900 150 MHz path is upconverted via mixer 94 to the 1850 to 1910 MHz transmit band, then follow the PCS 1900 transmit path to the antenna. Similarly, for the AMPS signal, the 225 MHz path is upconverted via mixer 92 to the 869 to 894 MHz AMPS transmit band and follows the AMPS transmit path to the antenna.

The signals from the mixers are amplified by preamplifiers 96, 98 before passing through rf SAW filters 26, 28, through power amplifiers for further amplification, through a further filter the PCS filter 18 for the digital signals and the duplex filter for the analogue signals, switch 14 to the antenna 12.

Referring now to the local oscillators, they receive a 13 MHz signal which is processed through dividers and power control means under the control of control signals: this allows the local oscillators to operate in the PCS 1900 receive mode, the PCS1900 transmit mode or the AMPS mode. Associated with the first local oscillator, there are band control means operable to adjust the local oscillator frequency in response to channel detection means which detect the channel employed in any communication. In the case of the mobile initiating a call then the channel detection means will be able to detect which channels are available and be able to effect the control switches for the PCS1900-AMPS circuits as appropriate. The programmable dividers operate under the control of data, clock and enable commands. The prime second local oscillator 2LO produces a fixed frequency signal at 900 MHz, and employs a feedback path to ensure that the frequency is maintained. By the use of a voltage controlled oscillator, variations in the input 13 MHz signal can easily be overcome. The second local oscillator frequency can thus be set dynamically to 225, 180 or 150 MHz dependent on the system and transmit or receive.

The synthesiser first local oscillator accomplishes dual mode operation by having a dual band local oscillator which tunes either 1700 - 1760

MHz for the PCS 1900 or 1049 to 1074 MHz for AMPS transmit and receive. Additionally, the first local oscillator VCO in PCS 1900 mode has its tuning range constrained so that fast tuning (commensurate with GSM protocol requirements) can be achieved. This is carried out by having switched intermediate frequencies between receive (225 MHz) and transmit (150 MHz) as shown in Figures 2 and 3. In the AMPS case, the first local oscillator VCO tunes in the band 1049 to 1074 MHz for simultaneous transmit and receive modes. In the case of PCS1900 the 1LO tunes in 200 kHz spaced channels and for AMPS in 30 kHz channels, defined by the by R/Q divider on the reference to the phase lock loop, and the programmable divider.

In order to implement a dual mode radio architecture, problems arise in the case of separate frequencies in various circuits. There is a danger that intermodulation products arise which will distort signals. Thus the case of a single substrate is not appropriate because of the case in which intermodulation products will develop. A three chip 'horizontal' partitioning is convenient, with a chip to carry the receive front end electronics; a chip to carry the transmit front end electronics and a chip to carry the two local oscillators. Such a partitioning is necessary whereby the transmit intermediate frequencies do not interfere with the receive path. It is possible to utilise a single chip which is readily available for frequency synthesis, and this will reduce spurious clock interference into transmit and receive paths. This minimum complexity three chip solution radio architecture keeps the frequency generation simple and easily realisable. Simple low shape factor filtering should suffice for the transmit intermediate frequencies. Standard ceramic filters can be used to separate the PCS1900 and AMPS transmit and receive bands, with the AMPS filter being of the duplexer type. An antenna switch is included to select the PCS transmit or receive, or the AMPS duplexed transmit and receive.

A further embodiment of the radio architecture uses an additional receive IF as shown in Figures 5 and 6. In this case the first receive IFs at 225 MHz and 180 MHz, being PCS1900 and AMPS respectively, are mixed down to a common second IF of 45 MHz using a second local

oscillator at 180 MHz or 225 MHz derived from the prime 2LO at 900 MHz. This architecture still uses only two phase locked local oscillators to derive all the frequencies required. The reason for an additional IF at 45 MHz is that it may prove more practicable for a silicon integrated solution.

Whilst the invention has been described in relation to PCS1900 and AMPS signals, by suitable choice of intermediate frequencies, the method described can be extended to other dual frequency/protocol scenarios.

CLAIMS

1 A radio front end transceiver operable to receive and transmit radio signals in different frequency bands and modulation formats, the transceiver comprising;

receive and transmit paths for each modulation format, wherein common receive and transmit intermediate frequency circuitry is employed and the local oscillator requirements are derived from two frequency synthesisers.

2 A radio front end transceiver according to claim 1 wherein a single first local oscillator is used and the required dual mode operation is achieved by using a dual band voltage controlled oscillator and a programmable synthesiser.

3 A radio front end transceiver according to claim 2, wherein the first local oscillator employs overlap tuning in order to constrain the voltage controlled oscillator tuning range appropriate for the dual band.

4 A radio front end transceiver according to any one of claims 1, 2 or 3, wherein the transceiver comprises a single second local oscillator is used, wherein the required dual mode operation is achieved by integer division of the local oscillator to derive the required local oscillator input signals.

5 A radio front end transceiver according to any one of claims 1 to 4, wherein the higher frequency radio system local oscillator bands are arranged to overlap, by switching intermediate frequencies, whereby the tuning range is constrained to within that achievable for a defined speed of phase lock loop.

6 A radio front end transceiver according to any one of claims 1 to 5, wherein the transceiver is provided with a means to determine the operational mode.

7 A radio front end transceiver according to any one of claims 1 to 6, wherein an additional intermediate frequency is employed for receive and transmit, without the need to provide additional oscillators.

The Patent Office

15

Application No: GB 9603316.2
Claims searched: 1 to 7

Examiner: M J Billing
Date of search: 16 April 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): H3A AB; H4L LDSC, LECX.

Int Cl (Ed.6): H04B 1/40, 1/50, 1/54, 1/56; H04Q 7/32, 7/38.

Other: ONLINE : WPI.

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB1601708	(TEXAS INSTRUMENTS) - Figs.2,5A,6A,7A; page 3 lines 59-65, page 8 lines 40-51, page 21 lines 41-47	1,2,4,6,7 at least
X	EP0678974A2	(NOKIA) - Figs.1,2; Abstract	1,2,4,6 at least
X	EP0656735A2	(A T & T) - Fig.3	1,6 at least
X	EP0621683A2	(NOKIA) - Fig.1	1,6 at least
X	EP0595781A2	(ERICSSON-GE) - Figs.1A,1B; page 3 lines 27-35	1,2,4,6 at least
X	EP0581573A1	(NOKIA) - whole document	1,6 at least

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
& Member of the same patent family
A Document indicating technological background and/or state of the art.
P Document published on or after the declared priority date but before the filing date of this invention.
E Patent document published on or after, but with priority date earlier than, the filing date of this application.

Europäisches Patentamt
European Patent Office
Office européen des brevets

epoline® Kundenservice

Ihr erster Ansprechpartner bei allen Fragen zum Patenterteilungsverfahren

epoline@epo.org
www.epoline.org

Entnehmen Sie die epoline® Karte und klappen Sie die Schutzfolie über die Vorderseite. Tragen Sie die Karte immer bei sich. Sie ist Ihr kürzester Weg zu den gewünschten Informationen über das Patenterteilungsverfahren.

epoline® Kundenservice

Website:	www.epoline.org	Tel.: + 31 (0) 70 340 4500
E-mail:	epoline@epo.org	Fax: + 31 (0) 70 340 4600

Öffnungszeiten:
Montag bis Freitag von 8.00 Uhr bis 18.00 Uhr MEZ

DOCKET NO: GR 00 P 1760
SERIAL NO: 09/836,981
APPLICANT: Boos

LERNER AND GREENBERG P.A.
P.O. BOX 2480
HOLLYWOOD, FLORIDA 33022
TEL. (954) 925-1100